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APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE.

APPLICATION NUMBER: 60/381,289

FILING DATE: May 17, 2002

RELATED PCT APPLICATION NUMBER: PCT/US03/02058

By Authority of the  
COMMISSIONER OF PATENTS AND TRADEMARKS



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PTO/SB/16 (10-01)

Approved for use through 10/31/2002. OMB 0651-0032

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

Express Mail Label No.

EU140616592US

**INVENTOR(S)**

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
GERALD DONALD JONATHAN V.	ANDREWS CASPAR	HOCKESSIN, DELAWARE WILMINGTON, DELAWARE

☒ Additional inventors are being named on the 1 separately numbered sheets attached hereto**TITLE OF THE INVENTION (500 characters max)**

COLOR FILTERS

Direct all correspondence to:

**CORRESPONDENCE ADDRESS**☒ Customer Number  
OR

23906

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**\*23906\***

PATENT TRADEMARK OFFICE

☐ Firm or  
Individual Name

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**ENCLOSED APPLICATION PARTS (check all that apply)**☒ Specification Number of Pages

11

☐ CD(s), Number☐ Drawing(s) Number of Sheets☒ Other (specify)

FEE SHEET

☐ Application Data Sheet. See 37 CFR 1.76**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT**☐ Applicant claims small entity status. See 37 CFR 1.27.☐ A check or money order is enclosed to cover the filing feesFILING FEE  
AMOUNT (\$)☒ The Commissioner is hereby authorized to charge filing  
fees or credit any overpayment to Deposit Account Number:

04-1928

160.00

☐ Payment by credit card. Form PTO-2038 is attached.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.☐ Yes, the name of the U.S. Government agency and the Government contract number are: \_\_\_\_\_.

Respectfully submitted,

Date 05/17/02

SIGNATURE

TYPED or PRINTED NAME JESSICA M. SINNOTT

TELEPHONE 302-992-4895

REGISTRATION NO.

34,015

(If appropriate)

Docket Number

CL2124 US PRV

**USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT**

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

**PROVISIONAL APPLICATION COVER SHEET**  
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Docket Number		CL2124
<b>INVENTOR(S)/APPLICANT(S)</b>		
Given Name (first and middle [if any])	Family or Surname	Residence (City and either State or Foreign Country)
JEFFREY SCOTT	METH	LANDENBERG, PENNSYLVANIA

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# FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

☐ Applicant Claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT (\$ ) 160

## Complete if Known

Application Number unknown  
Filing Date MAY 17, 2002  
First Named Inventor GERALD DONALD ANDREWS  
Examiner Name unknown  
Group / Art Unit unknown  
Attorney Docket No. CL2124 US PRV

## METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit  
Account  
Number

04-1928

Deposit  
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Name

E. I. du Pont de Nemours and Company

The Commissioner is authorized to: (check all that apply)

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## FEE CALCULATION

### 1. BASIC FILING FEE

Large Entity		Small Entity		Fee Description	Fee Paid
Fee Code	Fee (\$)	Fee Code	Fee (\$)		
101	740	201	370	Utility filing fee	
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	160
SUBTOTAL (1)					(\$ ) 160

### 2. EXTRA CLAIM FEES

Total Claims  -20 =  0 X  18 =  0  
Independent Claims  -3 =  0 X  84 =  0  
Multiple Dependent ☐ X  280 =  0

Large Entity		Small Entity		Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ ) 0

\*or number previously paid, if greater; For Reissues, see above

## FEE CALCULATION (continued)

### 3. ADDITIONAL FEES

Large Entity		Small Entity		Fee Description	Fee Paid
Fee Code	Fee (\$)	Fee Code	Fee (\$)		
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	


Other fee (specify) \_\_\_\_\_

\*Reduced by Basic Filing Fee Paid

SUBTOTAL (3)

(\$ ) 0

## SUBMITTED BY

Name (Print/Type)	JESSICA M. SINNOTT	Registration No. Attorney/Agent	34,015	Telephone	302-992-4895
Signature		Date	MAY 17, 2002		

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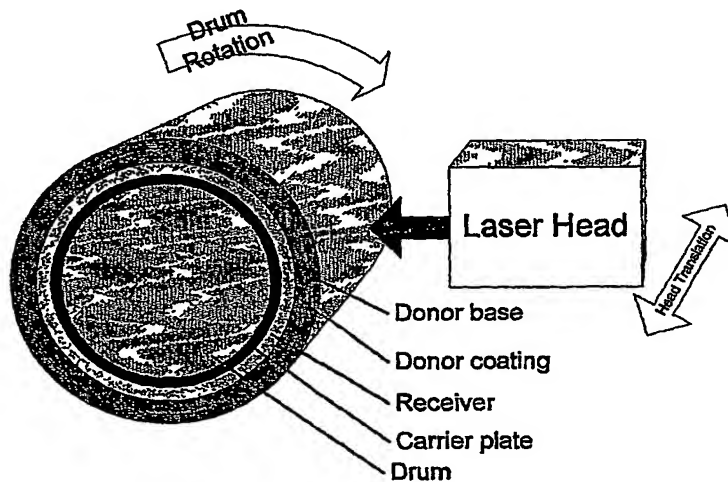
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## Color Filters

### I. Thermal Imaging Equipment

Color filter images were prepared utilizing two different versions of imaging equipment. The first was a conventional drum type imager comprising a Creo Model 3244 Spectrum Trendsetter (Creo Inc., Vancouver, Canada) equipped with a 20W laser head operating at a wavelength of 830 nm, suitable for imaging of flexible receivers. Imaging assemblages were exposed from the back side through the donor film base as shown schematically in Figure 1. Films were mounted using vacuum hold down to a standard plastic carrier plate clamped mechanically to the drum. Control of the laser output was under computer control to build up the desired image pattern. The desired three color image was built up by sequentially exposing the red, green and blue donor films. The exposure order for the colors can be varied according to other system requirements (e.g. optimal exposure characteristics).

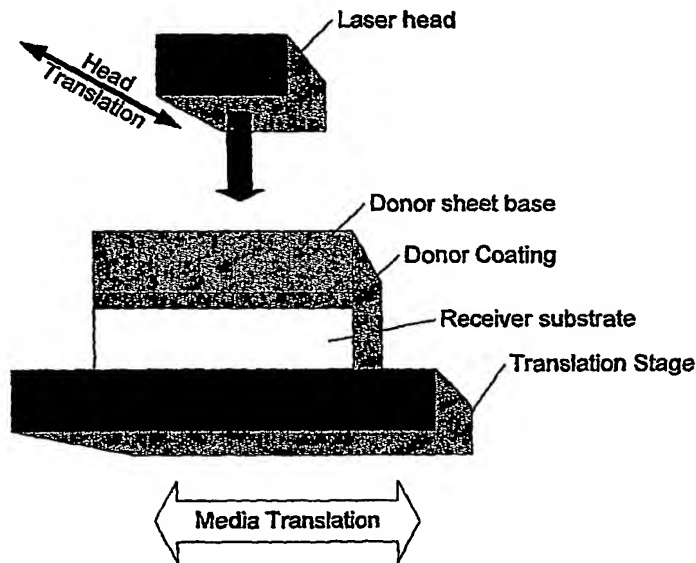
Figure 1. Layout of drum type imager.



The second imager (the "flatbed") employed an identical imaging head, but was based on a flatbed format rather than the Trendsetter drum format. The flatbed imager is preferred for exposure of relatively rigid, flat samples. This apparatus is shown schematically in Figure 3. The sample to be exposed was mounted using vacuum hold down to a translation stage positioned below the imaging head. During exposure the sample was translated past the imaging head at a speed of 1.0 – 1.2 m/s. Following the completion of each exposure pass, the imaging head was translated in the direction orthogonal to the sample translation to move a new unexposed area of film in front of the laser for the next imaging pass. This process was repeated to build up the completed exposure. As in the drum imager, the desired three color image is prepared by sequentially exposing the red, blue and green donors to the same receiver glass.

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Figure 3. Schematic layout of the flatbed thermal imager.



For both imaging systems, laser power was controllable and was adjusted in an iterative fashion to optimize image quality as judged by visual inspection of the transferred image on the receiving surface.

## II. Glass

Images prepared via direct to glass imaging were prepared on Corning 1737 display grade glass (0.7 mm thick). Optionally, the glass can be previously imaged with a useful pattern. In one embodiment, prior to thermal imaging of the colors, a pattern of opaque chrome grid lines was prepared on the glass using conventional photolithographic processes. The chrome mask pattern is also frequently referred to as a black mask. The black mask grid pitch was approximately  $90\mu \times 300\mu$ , typical of a conventional XGA display for laptop computing applications. The glass used in imaging was ca. 12" x 14" in size with the black mask pattern covering an area of ca. 8" x 10". The donor films used in imaging were about 17" x 17".

Prior to preparation of the glass for imaging, the glass was carefully cleaned. Surface debris was first removed by blowing high pressure ionized nitrogen gas (SIMCO Top Gun Ionizing Air Gun, Model 4005105). The glass was then washed with soap (Micro® brand cleaner), rinsed with water, isopropanol and finally with deionized water. The glass was dried under nitrogen purge. Immediately prior to application of the receiver film (see below) the glass was again cleaned with high pressure nitrogen.

## III. Preparation of Materials

### A. Chain Transfer Agent

This material was prepared as described in US Patent 5,362,826, Berge, et. al.

A 500 liter reactor was equipped with a reflux condenser and nitrogen atmosphere. The reactor was charged with methyl ethyl ketone (42.5 kg) and propyl-bis(borondifluorodimethylglyoximate) Cobaltate (III) (Co III DMG) (104 g) and the contents brought to reflux. A mixture of Co III DMG (26.0 g), methyl methacrylate (260 kg), and methyl ethyl ketone (1.6 kg) was added to the reactor over a period of 4 hours. Starting at the same time, a mixture of Vazo 67 ® (5.21 kg) and methyl ethyl ketone (53.1 kg) was

added to the reactor over a period of 5 hours. After the additions, the reactor contents were kept at reflux for another ½ hour. After cooling, this yielded 372 kg of a 70 wt % solution of Chain Transfer Agent (a chain transfer agent solution), which was used directly in the polymerizations.

#### **B. Acrylic Latex**

Tg (Glass transition temperature) values reported are mid-point temperatures in degrees Centigrade from DSC scans recorded according to ASTM D3418-82.

Molecular weights were measured by gel permeation chromatography (GPC). The equipment used consisted of the following: Columns, 2-5 mm x 300 mm x 7.5 mm (Poly Lab part# 1110,6500); Detector, Waters (Waters, Inc., Milford, MA) 410 Refractive Index detector; Pump, Waters 590; and Waters column heater. Conditions used were: Refractive Index detector internal temperature, 30°C; Column heater temperature, 30°C; THF solvent, 0.025% BHT inhibited (from Omnisolv, part# TX0282,1 distilled LC grade); Flow rate, 1 ml/min; Concentration, 0.1% (10 mg/10 ml). Samples were prepared by dissolving parts of the samples used for solids determination overnight with gentle shaking, and then filtering through 0.5um filter (Millipore, Bedford, Mass., part# SLSR025NB).

Dynamic light scattering was performed using Brookhaven Instrument BI-9000AT digital correlator (Brookhaven Instruments, Brookhaven, NY). An argon-ion laser with wavelength 488 nm and power 200 mW was used. Measurements were made at room temperature with scattering angle 60°. The samples were diluted 200 µL into 20 mL water then again 100 µL into 20 mL water, and then filtered with 0.45 micron filter. The results are reported as diameter (particle size) in nm units. For general discussions of the determination of particle sizes by quasielastic light scattering, see Paint and Surface Coatings: Theory and Practice, ed. By R. Lombourne, Ellis Horwood Ltd., West Sussex, England, 1987, pp. 296-299, and The Application of Laser Light Scattering to the Study of Biological Motion, ed. By J. C. Earnshaw and M. W. Steer, Plenum Press, NY, 1983, pp. 53-76.

An acrylic latex (PR-1) of controlled molecular weight was prepared as described below, using the chain transfer agent solution produced above, according to the method in Antonelli, et. al., US Patent 5,773,534. A acrylic latex of high molecular weight polymer resin (PR-2) was prepared by the same method omitting the chain transfer agent.

A 3-L, round bottom flask was equipped with a condenser, addition funnel, mechanical stirrer, and temperature controller probe. Polymerizations were carried out under a nitrogen atmosphere in the flask. Monomers and initiators were commercially available (Aldrich Chemical Co., Milwaukee, WI) and used as received. The surfactant was Polystep B-7, a 29 weight % solution of ammonium lauryl sulphate in water, available from Stepan Co., Northfield, IL.

*Table 1. Ingredients for Synthesis of Acrylic Latex PR-1*

Reagent	Grams
Polystep B-7	6.90
Ammonium Persulfate	0.40
Methyl Methacrylate	244.00
Glycidyl Methacrylate	8.00
Butyl Acrylate	120.00

Methacrylic Acid	12.00
chain transfer agent solution	16.00

The materials shown in Table 1 were employed in the quantities shown. 700 mL of water and the Polystep B-7 were charged to the flask, which was stirred and heated to 85°C. The ammonium persulfate was dissolved in 100 mL water, and 80 mL of this persulfate solution was added to the flask. Half of the weight of the monomers, except for the methacrylic acid, were mixed and charged to the addition funnel, and about 20 mL was added immediately to the flask. After a few minutes, the remainder in the addition funnel was added, dropwise, over a time period of about 1 hour, while the temperature in the flask was held between 85 and 90°C. The remaining monomers, including the methacrylic acid, were mixed, added to the addition funnel, and added to the reaction over an additional time period of 1 hour, still keeping the temperature in the flask between 85 and 90°C. After the addition of the remaining monomers was finished, the remaining persulfate solution was added, and the acrylic latex was heated at 85°C for ½ hour, cooled to room temperature, and filtered through paint strainers into plastic bottles.

The acrylic latex may be neutralized in the reactor (neutralized form) or it may be used as prepared (acidic form). The neutralized acrylic latex has poorer storage stability but eliminates the requirement for neutralization during the coating steps described below. The acidic form of the acrylic latex which exhibits improved the storage stability requires neutralization during the coating steps. Neutralization of the acrylic latex was accomplished by adding 18g of a 25% w/w solution of N,N-dimethylethanolamine in water to the acrylic latex in the reaction flask prior to filtration. The neutralized acrylic latex had a pH of 8.5.

Solids content was measured by putting about 5 grams of acrylic latex in a tared, 5-cm aluminum pan, which was placed in a 75°C vacuum oven at about 400 mm Hg vacuum for 1 to 2 days.

A second acrylic latex (PR-2) was made by the procedure above with the monomer content shown in Table 2. The compositions and analytical data for the polymer resin of the acrylic latex are summarized in Table 2. Compositions of the polymers are in weight percent on polymer solids based on the chain transfer agent solution, MMA, BA, MAA, and GMA.

Table 2. Composition and Analytical Data for Polymer Resins.

Sample	Solids	Chain Transfer Agent Solution	MMA	BA	MAA	GMA	Particle Diameter (nm)	Tg (°C)	Mn	Mw
PR-1	33.1	4	61	30	3	2	86	55	2.0 x 10 <sup>4</sup>	8.5 x 10 <sup>4</sup>
PR-2	33.4	0	48	40	10	2	91	32	-	-

### C. Pigment Dispersions

Pigment dispersions were prepared by dispersing the appropriate pigment in polymeric dispersants in basic aqueous media. Color filters for LCD display applications require very high transparency (see for instance T. Sugiura, "EBU Color Filters for LCDs", Society for Information Display, Digest of Technical Papers, 2001, 33, p146-9). In order to meet these transparency requirements, the pigments used in this work were generally milled to give particle size distributions with greater than 90% of the particles having



diameters less than 200 nm as determined by conventional light scattering methods. A list of the dispersions employed in the production of the color filters is shown in Table 4.

Dispersion PD-R2 was prepared as described in Chu, et. al., US Patent 5,231,131 utilizing an aqueous graft copolymer dispersant.

*Table 4. Pigment dispersions used in preparation of color filter donor films. Abbreviations for pigments are as defined in "The National Printing and Ink Research Institute Raw Materials Data Handbook", Volume 4, Second Edition, 2000.*

Dispersion	Color	P:B Ratio	% Pigment	% Solids	Pigment
PD-B1	Blue	2.0	33.7	50.5	Pigment Blue 15:6
PD-G1	Green	2.3	35.0	50.0	Pigment Green 36
PD-R3	Red	1.5	24.0	40.0	Pigment Red 254
PD-R1	Red	3.5	15.4	45.0	Pigment Red 177
PD-R2	Red	1.5	15.5	25.3	Pigment Red 149
PD-V1	Violet	2.3	34.0	48.5	Pigment Violet 23
PD-Y2	Yellow	1.5	25.0	42.0	Pigment Yellow 74
PD-Y1	Yellow	2.3	28.0	40.0	Pigment Yellow 83

#### IV. Glass Receiver Film

A receiver film was prepared as follows. A coating composition was prepared with the ingredients shown in Table 6. The composition was coated to a dry coating weight of 30 mg/dm<sup>2</sup> on a supporting base. The coating composition was coated on the Elvax 550 side of a supporting base having a 2.5 mil thick Elvax® 550 (ethylene vinyl acetate copolymer, DuPont) layer coated onto 4 mil thick Cronar® 471X (polyester, DuPont support film). The coated supporting base was dried at temperatures which increased from an initial value of about 38°C to a final value of about 65°C over a period of about 5 minutes. The smooth dried coated surface of the film was covered with a smooth polyethylene coversheet to prevent contamination of the coated surface during subsequent handling.

*Table 6. Receiver film coating composition (RF-1).*

Material	Weight, grams
PR-2 acrylic latex	12574
Zonyl® FSA (25% solids solution)	43.2
N,N-Dimethylethanolamine	109.6
Butyl cellosolve	1106
Distilled Water	22186

#### V. Glass Pretreatment Process

The receiver glass was prepared for imaging by lamination of the glass receiver film. The lamination was carried out Riston® Model HRL-24 Roll Laminator (DuPont). After removing the cover sheet, the receiver film (RF-1) was placed with the coating side in contact with the cleaned surface of the glass (the

surface with the preformed opaque chrome mask). Lamination was carried out with the rollers heated to 97°C at a speed of 0.2 meters/minute. The laminator air feed was adjusted to a pressure of 40 psi. Following lamination, the assembly was allowed to cool completely before removal of the coating support. In practice the removal of the coating support was generally carried out immediately prior to imaging in order to protect the receiver coating surface from contamination in handling. After removal of the coating support, the surface of the receiver coating on glass is very smooth. Measurement of the surface roughness of the laminated receiver coating with a Wyko Model RST Plus Surface Profiler (Wyko Corp., Tucson, Arizona) gave an average roughness ( $R_a$ ) of 28 nm over a measurement area of 1.08 mm<sup>2</sup>.

## VI. Common Donor Materials

In addition to the polymer resins and dispersions described above, additional raw materials required for preparation of the red, blue and green donor films were prepared as described below.

### A. Film bases

Donors were coated on metallized polyester film base as summarized in Table 8. All raw polyester base film was provided by DuPont Teijin Films (Wilmington, Delaware). Metal coatings were applied by CP Films Inc. (Martinsville, Virginia).

Table 8. Base films used in preparation of red, green and blue donor films. Films were metallized to 50% visible light transmission with metallic chromium.

Base Film	Film Thickness (mils)	Comments
Melinex® 473	4	-
Melinex® 6442	4	This base incorporates a filter dye absorbing at 670 nm (OD=0.6+/- 0.1) with OD < 0.07 at 830 nm.
Melinex® LJX111	1	-
Melinex® 453	2	-

### B. Additional Raw Materials

Additional commercially available raw materials required for preparation of donor films are summarized in Table 10.

Table 10. Additional raw materials.

Material	Abbreviation	Source
Zonyl® FSA (supplied and used as a 25% solids solution)	-	DuPont
Butyl cellosolve	-	Sigma-Aldrich
Ammonium hydroxide	-	-
2-[2-[2-chloro-3-[[1,3-dihydro-1,1-dimethyl-3-(4-sulfobutyl)-2H-benz[e]indol-2-ylidene]ethylidene]-1-cyclohexen-1-yl]ethenyl]-1,1-dimethyl-3-(4-sulfobutyl)-1H-benz[e]indolium, inner salt	NIR-1	H. W. Sands (Jupiter, Florida)

## VII. Donor Formulations

Donor film formulations are summarized in Table 12. The amounts of materials listed in Table 12 were added to a stirred 40L stainless steel vessel under air in the order water, Zonyl® FSA, NIR-1, polymer

resin (either pre-neutralized or neutralized with the specified amount of 3% ammonium hydroxide immediately prior to use) and pigment dispersions. The formulations were then stirred for 24 – 48 hours and filtered through a 5 $\mu$  filter. These formulations were coated onto the specified film bases and were dried at temperatures which increased from an initial value of about 38°C to a final value of about 65°C over about 5 minutes.

Table 12. Formulations for donor coatings. All weights are listed in grams.

Material	CF-1R	CF-1B	CF-1G	CF-2R	CF-2B	CF-2G
Film Base	Mellnex® 8442	Mellnex® 473	Mellnex® 473	Mellnex® LjX111	Mellnex® 453	Mellnex® 453
Metallization	Cr at 50%T	Cr at 60%T	Cr at 50%T	Cr at 50%T	Cr at 50%T	Cr at 60%T
Optical Density(a)	2.40 @ 473 nm 1.45 @ 551 nm	2.03 @ 610 nm 1.99 @ 763 nm	1.73 @ 655 nm	1.97 @ 553 nm	2.23 @ 763 nm	1.53 @ 423 nm
Coating weight (mg/dm <sup>2</sup> )	18	10.6	16.1	11.1	13.9	14.9
PD-B1	-	2131.2	-	-	3853.0	-
PD-V1	-	111.2	-	-	201.0	-
PD-G1	-	-	1265.1	-	-	4073.2
PD-R1	308.6	-	-	-	-	-
PD-R2	4263.2	-	-	-	-	-
PD-R3	-	-	-	2531.3	-	-
PD-Y1	-	-	-	723.2	-	1272.8
PD-Y2	-	-	388.8	-	-	-
PR-1 (Neutralized)	2647.6	2913.2	1114.6	-	-	-
PR-1 (Acidic)	-	-	-	1344.7	5255.2	3911.0
Zonyl(r) FSA	43.2	43.2	24.0	38.0	78.1	79.2
NIR-1	37.2	37.2	20.6	31.0	67.1	68.2
Ammonium hydroxide	-	-	-	33.7	131.5	97.8
Deionized water	10701.3	12764.0	7188.9	13300.2	24670.0	26498.0
Total Solution Weight	18001	18000	10000	18000	34256	36000
Percent Solids	12.00%	12.00%	12.00%	10.00%	11.50%	11.05%

Notes

(a) Optical densities were determined on fully dried coatings on 50%T base vs. air reference.

## VIII. Direct to Glass Imaging

### A. Exposure conditions

Color filter samples on glass were prepared using flatbed imager and the exposure parameters indicated in Table 14. One color filter (CF-1) was prepared using donors CF-1R, CF-1B and CF-1G and two color filters (CF-2A and CF-2B) were prepared using donors CF-2R, CF-2B and CF-2G. During exposure of the donor films, the ambient environment was maintained at a preferred exposure condition of  $40 \pm 5\%$  RH and  $22 \pm 2^\circ\text{C}$ .

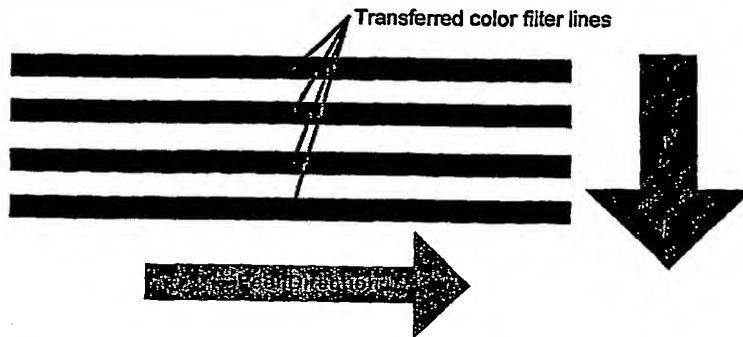
Table 14. Exposure parameters used in production of color filter samples.

Exposure Setting	CF-1			CF-2A and CF-2B		
	CF-1R	CF-1B	CF-1G	CF-2R	CF-2B	CF-2G
Laser Power (watts)	6.25	5.50	5.75	4.75	4.50	4.75
Surface Depth (microns)	120	85	75	40	72	52
Swath Width (microns)	958	958	958	953	956	959
Writing Velocity (meter/sec)	1.2	1.2	1.2	1.2	1.2	1.2
Exposure order	3	1	2	2	3	1

### B. Imaging Procedures

Following the exposure of each donor film, the spent donor was separated from the glass surface in the following manner. This procedure has been shown to significantly increase image quality of the color filter line patterns. During the peeling process, a metal rod with diameter of 1.5" was held in firm contact with the donor film. The rod was then used to maintain a constant radius of curvature of the donor film during the peeling process. The peeling process was carried out a uniform speed of ca. 1.25 meters/minute. The direction of the peeling process was arranged parallel to the lines of the color filter pattern as shown in Figure 5.

Figure 5. Orientation of color stripes to peel direction. The black mask pattern has been omitted for clarity. The direction of apparent laser motion during the writing process is also indicated in the diagram.



Following exposure of the first color donor, vacuum channels were formed by the transferred pigment sandwiched between the receiver surface and the surface of the next donor to be imaged. These vacuum channels facilitate improved vacuum draw down of the second and third color to be imaged to the receiver.

### IX. Overcoating Film

An overcoating film was prepared using the composition listed in Table 16. This solution was coated with a #12 Meyer rod to give a dried coating on Melinex® 573 base. The film was dried for 12 minutes at 50°C to give a dried coating (82 mg/dm<sup>2</sup>). Preparation of the overcoating film with the low molecular weight polymer resin (PR-1) leads to improved surface smoothness of the final overcoated color filter assembly.

Table 16. Formulation of overcoating film (OC-1).

Material	Weight (grams)
PR-1 (neutralized)	86.62
Zonyl® FSA	0.14
Butyl cellosolve	7.34
Deionized water	5.89

A thinner version of the overcoating film was prepared (Table 18) and coated with a #8 Meyer rod and dried at 45°C for 18 minutes to give a dried coating (3.0 mg/dm<sup>2</sup>).

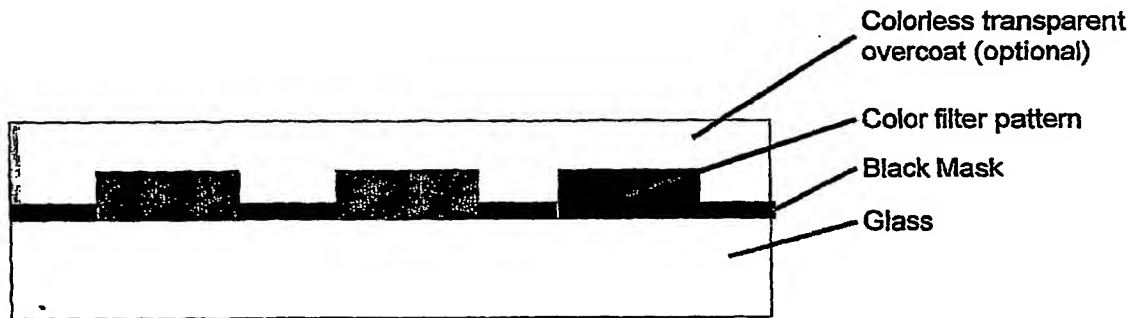
Table 18. Formulation for thin overcoating film (OC-2).

Material	Weight (grams)
PR-2 (Acidic)	111.75
Zonyl® FSA	0.50
Butyl cellosolve	12.50
Ammonium hydroxide (3% by weight)	2.79
Deionized water	72.46

## X. Overcoating Process

Following the transfer of the color filter pattern to the surface of the glass, it is optional to add a colorless transparent overcoat to the surface of the color filter as shown schematically in Figure 7. Various means may be employed to apply this overcoat. In one embodiment the overcoat may be laminated from a carrier sheet as described in more detail below. Alternatively the overcoat may be applied as a liquid by conventional spin coating technologies followed by thermal drying and annealing to yield the final durable overcoat.

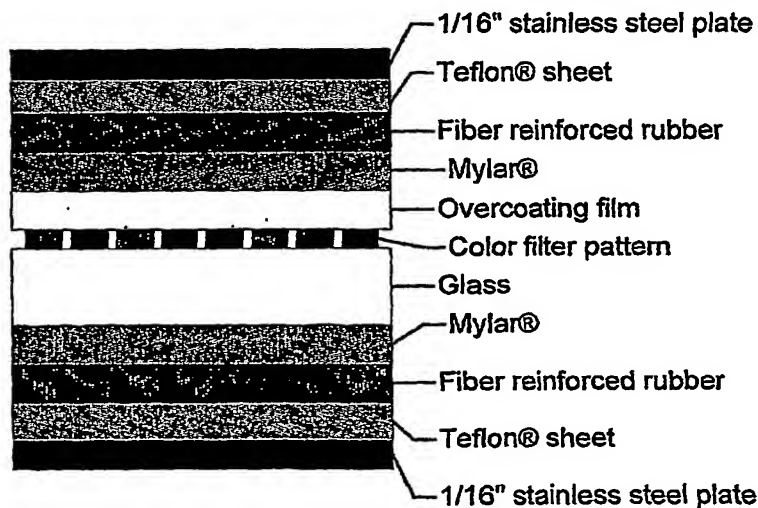
Figure 7. Schematic cross-section of the color filter pattern on glass showing the arrangement of the overcoat.



### A. Laminated Overcoat

The overcoat film described above can be laminated to the finished color filter using either a roll-through lamination process employing a laminator with heated rollers or a press laminator with heated platens. In a typical press lamination a lamination stack was prepared as shown in Figure 9.

Figure 9. Lamination stack used for lamination of the overcoat on to the color filter in a press laminator.



The lamination stack was placed in the vacuum laminator (Tetrahedron Model MTP13) and the sample chamber was evacuated to less than 5 torr. After evacuation, a series of up to nine bump cycles at 3 psi was carried out to remove any trapped air between the overcoat film and the color filter on glass. Lamination was then carried out at a temperature of 110°C and a pressure of 60 psi. Hold times varied from 3 to 60 minutes.

Application of the roll overcoat by roll through lamination was carried out using the Riston® Model HRL-24 laminator at 110°C with the feed air adjusted to 80 psi and at a translation speed of 0.1 meter/minute.

Samples overcoated by spin coating utilized conventional spin coating techniques. Following application of the overcoat solution, the samples were heated to completely remove the spin coating solvent.

The overcoating methods used for preparation of LCD display samples are summarized in Table 20.

*Table 20. Overcoating methods used for color filters used in preparation of LCD display samples.*

Sample	Overcoat method
CF-1	Press laminated, thick overcoat OC-1
CF-2A	Spin coated overcoat
CF-2B	Press laminated, thin overcoat OC-2

## **XI. Final Annealing**

Prior to incorporation of the color filters into functioning displays, the color filters were annealed at 200 °C for 60 minutes in air. The annealing process crosslinks the epoxy monomers to yield improved solvent resistance and mechanical properties for the annealed color filter. Samples which employed laminated overcoats were annealed after the application of the overcoat. Samples which employed spin coated overcoats were annealed prior to application of the overcoat. The annealing step also affects the bleaching of NIR dye without the requirement of incorporation of a chemical bleaching agent into the donor formulation. Alternatively a chemical bleaching like 1,3-dichloro-5,5-dimethyl-2,4-imidazolidinedione can also be incorporated in the compositions (in one or more of the receiver film, donor film, overcoating film or overcoating solution) to effect NIR dye bleaching.

## **XII. Incorporation of Color Filters into Liquid Crystal Displays**

Color filter samples CF-1, CF-2A and CF-2B were all successfully incorporated into functional active matrix liquid crystal displays using techniques which are well known within the liquid crystal display industry (see, for instance "Fundamentals of Active-Matrix Liquid-Crystal Displays", Sang Soo Kim, Society for Information Display Short Course, 2001 and U.S. Patent 5,166,026).